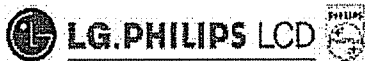


# EXHIBIT 11



LC230W01  
Liquid Crystal Display

Product Specification

## SPECIFICATION FOR APPROVAL

( ? ) Preliminary Specification

( ) Final Specification

Title	23.0" WXGA TFT LCD
-------	--------------------

BUYER	General
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LC230W01
SUFFIX	A2K2

\*When you obtain standard approval,  
please use the above model name without suffix

APPROVED BY	SIGNATURE DATE
/	
/	
/	

Please return 1 copy for your confirmation with  
your signature and comments.

APPROVED BY	SIGNATURE DATE
M.H Park / G. Manager	
REVIEWED BY J.T Kim / S. Manager	
PREPARED BY J.H.Yoon / Engineer	

**TV Products Engineering Dept.**  
**LG. Philips LCD Co., Ltd**



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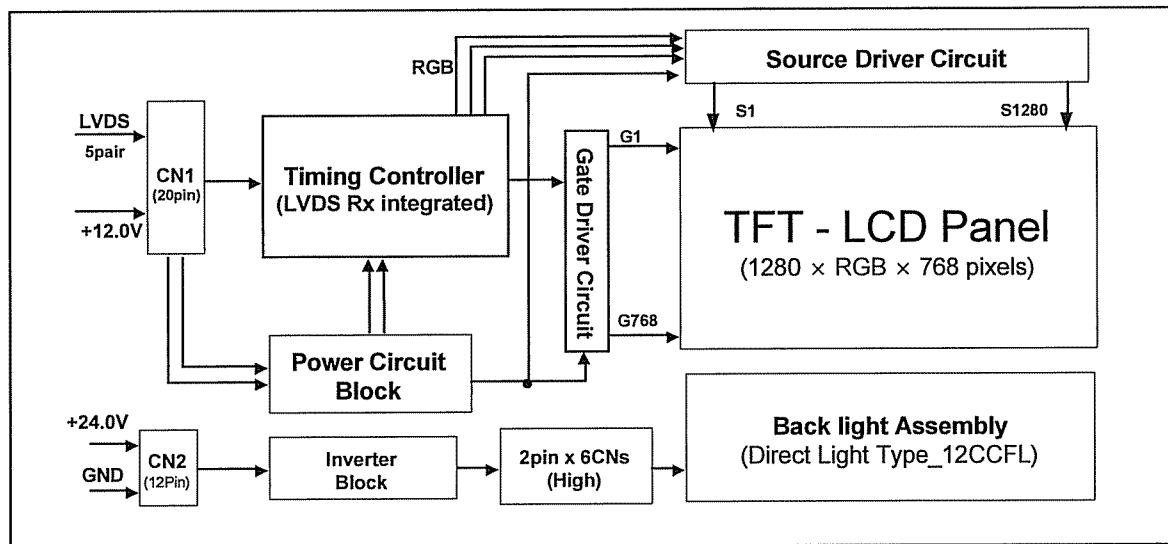
## Product Specification

### 1. General Description

The LC230W01 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has a 23.0 inch diagonally measured active display area with WXGA resolution (768 vertical by 1280 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16.7M(true) colors with 8Bit.

The LC230W01 has been designed to apply the 8Bit LVDS interface.

It is intended to support LCD TV, PCTV where high brightness, wide viewing angle, high color saturation, and high color are important.



### General Features

Active Screen Size	23.01 inches(584.40mm) diagonal
Outline Dimension	528.0(H) x 326.0(V) x 34.5(D) mm(Typ.)
Pixel Pitch	0.1305mm x 0.3915mm x RGB
Pixel Format	1280 horiz. By 768 vert. Pixels RGB strip arrangement
Color Depth	16.7M colors
Luminance, White	450 cd/m <sup>2</sup> (Center 1 points typ.)
Viewing Angle(CR>10)	View Angle Free
Power Consumption	Total 67.8Watt (Typ.)
Weight	2,700g (Typ.)
Display Operating Mode	Transmissive mode, Normally Black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer,



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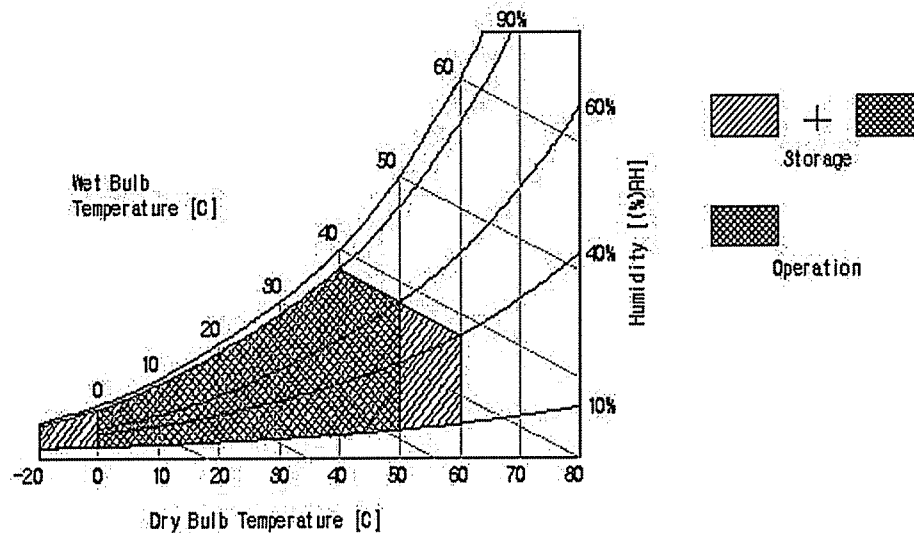
## 2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

**Table 1. ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	$V_{LCD}$	-0.3	+14.0	Vdc	at $25 \pm 5^{\circ}\text{C}$
Operating Temperature	$T_{OP}$	0	+50	$^{\circ}\text{C}$	1
Storage Temperature	$T_{ST}$	-20	+60	$^{\circ}\text{C}$	
Operating Ambient Humidity	$H_{OP}$	10	90	%RH	
Storage Humidity	$H_{ST}$	10	90	%RH	

Notes : 1. Temperature and relative humidity range are shown in the figure below.  
Wet bulb temperature should be  $39^{\circ}\text{C}$  Max, and no condensation of water.





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### 3. Electrical Specifications

#### 3-1. Electrical Characteristics

The LC230W01 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the CCFL/Backlight, is to power the inverter.

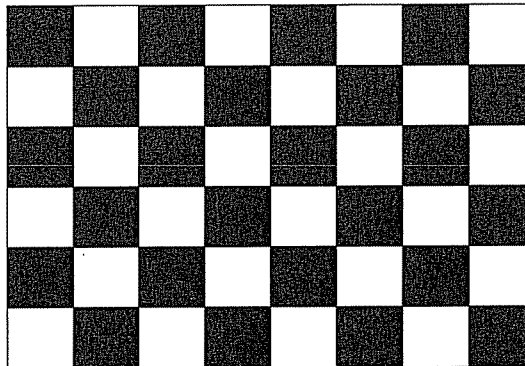
Table 2\_1. LCD PANEL ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
Module :						
Power Supply Input Voltage	$V_{LCD}$	11.4	12.0	12.6	Vdc	
Power Supply Input Current	$I_{LCD}$	-	230	270	mA	1
		-	280	360	mA	2
Power Consumption	$P_{LCD}$		2.76	3.24	Watt	1
Rush current	$I_{RUSH}$	-	-	2.0	A	3

Notes: 1. The specified current and power consumption are under the  $V_{LCD}=12.0V$ ,  $25^{\circ}C$ ,  $f_v=60Hz$  condition whereas mosaic pattern(8 x 6) is displayed and  $f_v$  is the frame frequency.

2. The current is specified at the maximum current pattern.

3. The duration of rush current is about 2ms and rising time of Power Input is 1ms(min).



Mosaic Pattern(8X6)



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Table 2\_2. INVERTER ELECTRICAL CHARACTERISTICS

Parameter			Symbol	Values			Unit	Notes
				Min	Typ	Max		
Inverter :								
Power Supply Input Voltage			V <sub>DDB</sub>	22.8	24.0	25.2	Vdc	
Power Supply Input Current			I <sub>DDB</sub>	-	2.71	3.20	A	1
Power Consumption			P <sub>B</sub>	-	65.0	77.0	W	1
Input Voltage for Control System Signals	BRTI Signal		VBI	0		3.3	V	
	B RTP Signal	Low	VBPL	0		0.8	V	
		High	VBPH	2.0		5.0	V	
	BRTC Signal	Low	VBCL	0		0.8	V	
		High	VBCH	2.0		5.0	V	
	PWSEL Signal	Low	VBSL	0		0.8	V	
		High	VBSH	2.0		5.0	V	
Lamp :								
Life Time				50,000			Hrs	2

- Notes : 1. The specified current and power consumption are under the typical supply Input voltage, 24.0V.  
 2. The life is determined as the time at which luminance of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at  $25 \pm 2^\circ\text{C}$ .  
 3. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 2Hrs in a dark environment at  $25^\circ\text{C} \pm 2^\circ\text{C}$ .



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### 3-2. Interface Connections

This LCD employs Two interface connections, a 20 pin connector is used for the module electronics and a 12Pin Connector is used for the integral backlight system.

#### 3-2-1. LCD Module

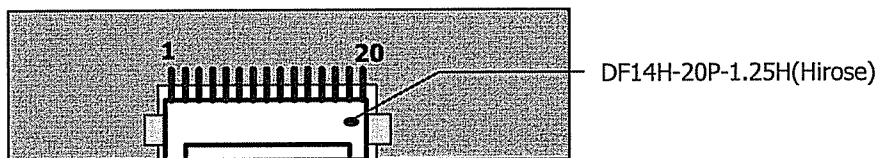
- LCD Connector : DF14H-20P-1.25H(Manufactured by Hirose) or Equivalent
- Mating connector : DF14-20S-1.25C(Manufactured by Hirose) or Equivalent

**Table 3. MODULE CONNECTOR PIN CONFIGURATION**

Pin No	Symbol	Description	Output Pin # (LVDS Tx)
1	$V_{LCD}$	Power Supply +12.0V	
2	$V_{LCD}$	Power Supply +12.0V	
3	GND	Power Ground.	
4	GND	Power Ground	
5	RXIN0-	LVDS Receiver Signal(-)	PIN#48
6	RXIN0+	LVDS Receiver Signal(+)	PIN#47
7	GND	Ground	
8	RXIN1-	LVDS Receiver Signal(-)	PIN#46
9	RXIN1+	LVDS Receiver Signal(+)	PIN#45
10	GND	Ground	
11	RXIN2-	LVDS Receiver Signal(-)	PIN#42
12	RXIN2+	LVDS Receiver Signal(+)	PIN#41
13	GND	Ground	
14	RXCLK IN-	LVDS Receiver Clock Signal(-)	PIN#40
15	RXCLK IN+	LVDS Receiver Clock Signal(+)	PIN#39
16	GND	Ground	
17	RXIN3-	LVDS Receiver Signal(-)	PIN#38
18	RXIN3+	LVDS Receiver Signal(+)	PIN#37
19	GND	Ground	
20	GND	Ground	

- Notes: 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
2. All  $V_{LCD}$  (power input) pins should be connected together.
3. Input Level of LVDS signal is based on the IEA 664 Standard.

#### Rear view of LCM





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**Table 4. REQUIRED SIGNAL ASSIGNMENT FOR FLATLINK'S Transmitter(THC63LVDM83A/LVDF83A)**

Pin #	Pin Name	Symbol	Description	Output
51	TxIN0	Red0 [LSB]	Red Pixel Data	Rx0- Rx0+
52	TxIN1	Red1	Red Pixel Data	
54	TxIN2	Red2	Red Pixel Data	
55	TxIN3	Red3	Red Pixel Data	
56	TxIN4	Red4	Red Pixel Data	
2	TxIN5	Red7 [MSB]	Red Pixel Data	Rx3- Rx3+
3	TxIN6	Red5	Red Pixel Data	Rx0- Rx0+
4	TxIN7	Green0 [LSB]	Green Pixel Data	
6	TxIN8	Green1	Green Pixel Data	Rx1- Rx1+
7	TxIN9	Green2	Green Pixel Data	
8	TxIN10	Green6	Green Pixel Data	Rx3- Rx3+
10	TxIN11	Green7 [MSB]	Green Pixel Data	
11	TxIN12	Green3	Green Pixel Data	Rx1- Rx1+
12	TxIN13	Green4	Green Pixel Data	
14	TxIN14	Green5	Green Pixel Data	
15	TxIN15	Blue0 [LSB]	Blue Pixel Data	Rx3- Rx3+
16	TxIN16	Blue6	Blue Pixel Data	
18	TxIN17	Blue7 [MSB]	Blue Pixel Data	Rx1- Rx1+
19	TxIN18	Blue1	Blue Pixel Data	
20	TxIN19	Blue2	Blue Pixel Data	Rx2- Rx2+
22	TxIN20	Blue3	Blue Pixel Data	
23	TxIN21	Blue4	Blue Pixel Data	
24	TxIN22	Blue5	Blue Pixel Data	
25	TxIN23	RES		Rx3- Rx3+
27	TxIN24	Hsync.	No connection, If unnecessary	Rx2- Rx2+
28	TxIN25	Vsync.	No connection, If unnecessary	
30	TxIN26	EN	Data Enable	
50	TxIN27	Red6	Red Pixel Data	Rx3- Rx3+

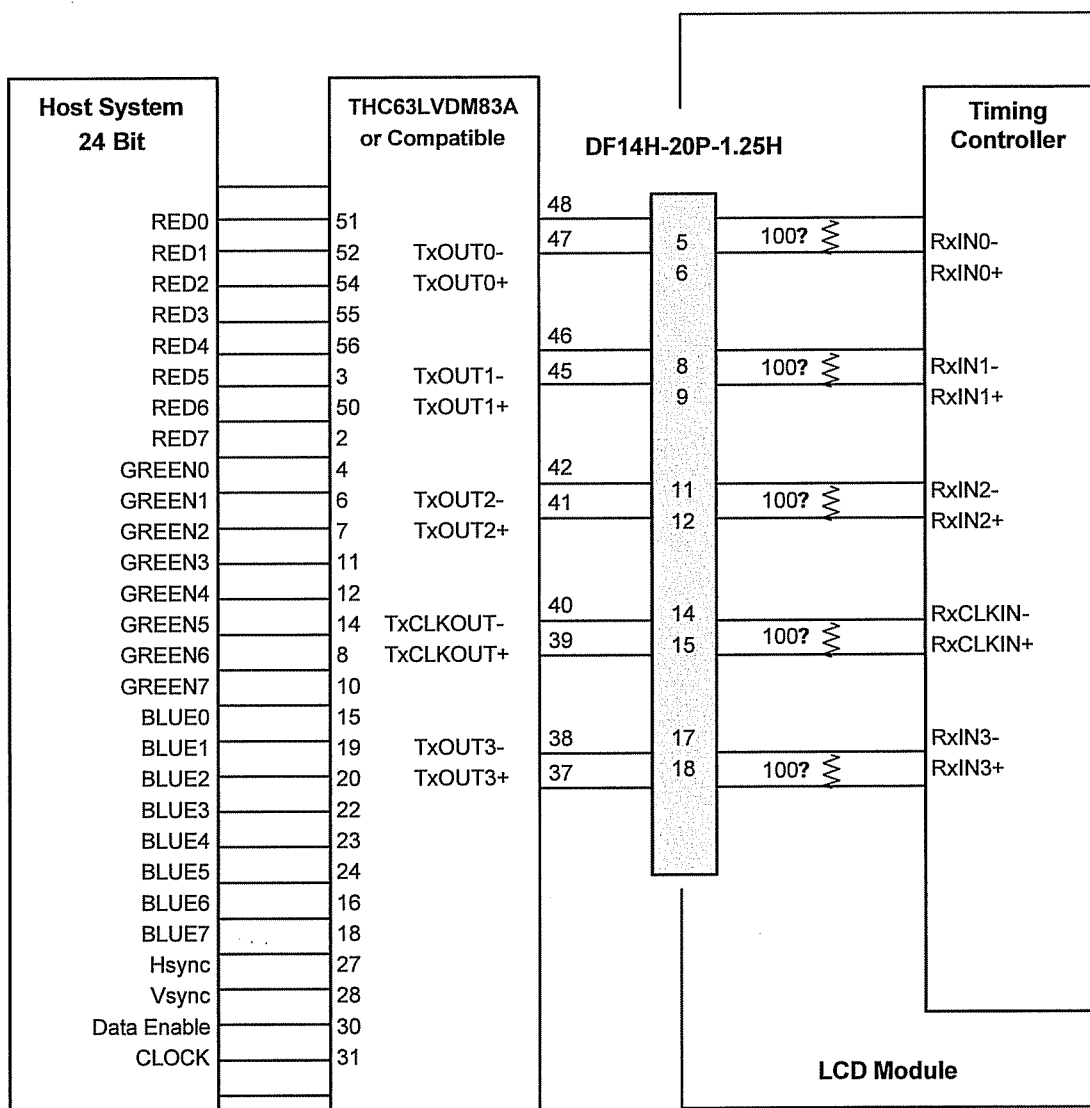
Notes: 1. Refer to LVDS Transmitter Data Sheet for detail descriptions.  
2. 7 means MSB and 0 means LSB at R,G,B pixel data.



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Table 5. REQUIRED SIGNAL ASSIGNMENT FOR LVDS Transmitter (THC63LVDM83A / LVDF83A)



Notes : The LCD Module uses a 100Ω resistor between positive and negative lines of each receiver input. Recommended Transmitter : See the data sheet for THC63LVDM83A(Thine Electronics Inc.)



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3-2-2. Backlight Inverter

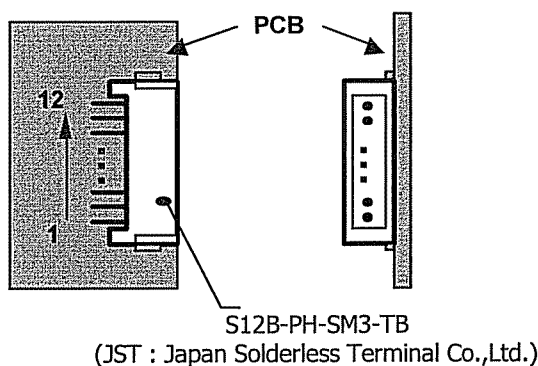
- Inverter Connector : S12B-PH-SM3-TB(Manufactured by JST) or Equivalent
- Mating Connector : PHR-12(Manufactured by JST) or Equivalent

**Table 6. INVERTER CONNECTOR PIN CONFIGURATION**

Pin No	Symbol	Description	Remarks
1	VDDDB	Power Supply +24.0V	
2	VDDDB	Power Supply +24.0V	
3	VDDDB	Power Supply +24.0V	
4	NC	Not Connection	
5	PWSEL	Select of luminance control signal method	Note 1
6	BRTTP	PWM Signal	
7	BRTI	Luminance Control by voltage method	
8	BRTC	Backlight ON/OFF Signal	On : High or Open, Off : Low
9	NC	Not Connection	
10	GND	Backlight Ground	Note 2
11	GND	Backlight Ground	
12	GND	Backlight Ground	

- Notes : 1. See "3-7 Luminance controls"
2. GND is connected to the LCD's metal frame.

**Rear view of LCM**





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### 3-3. Signal Timing Specifications

This is the signal timing required at the input of the LVDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 7. TIMING TABLE

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	12.2	12.5	-	?	
	Frequency	-	-	80	82	MHz	
Hsync	Period	tHP	1328	1648	-	tCLK	
	Frequency	fH	44.0	48.54	-	kHz	
	Width	tWH	8	16	-	tCLK	
Vsync	Period	tVP	775	810	-	tHP	PAL : 47~53Hz NTSC: 57~63Hz
	Frequency	fV	47	60	63	Hz	
	Width	tWV	2	6	-	tHP	
DE (Data Enable)	Horizontal Valid	tHV	1280	1280	1280	tCLK	
	Horizontal Back Porch	tHBP	16	80	-		
	Horizontal Front Porch	tHFP	24	272	-		
	Horizontal Blank	-	48	368	-		
	Vertical Valid	tVV	768	768	768	tHP	
	Vertical Back Porch	tVBP	3	20	-		
	Vertical Front Porch	tVFP	2	16	-		
	Vertical Blank	-	7	42	-		

Notes : Hsync period and Hsync width-active should be even number times of tCLK. If the value is odd number times of tCLK, display control signal can be asynchronous. In order to operate this LCM a Hsync., Vsync and DE(data enable) signals should be used.

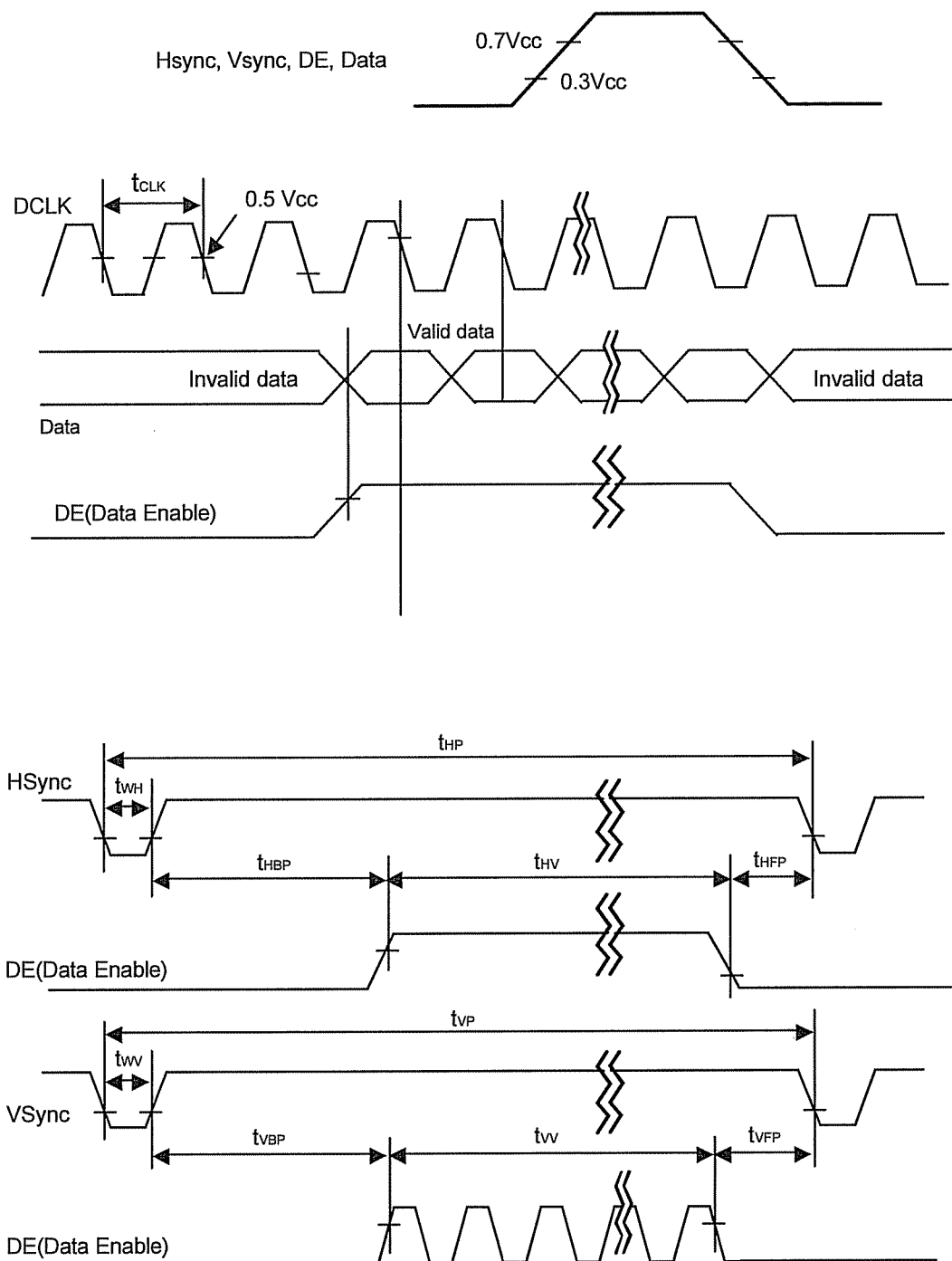
1. The performance of the electro-optical characteristics are may be influenced by variance of the vertical refresh rates.
2. Vsync, Hsync should be keep the above specification.
3. Hsync Period should be a double number of character (8).



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### 3-4. Signal Timing Waveforms



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## 3-5. Color Input Data Reference

The Brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 8. COLOR DATA REFERENCE

Color		Input Color Data																															
		RED								GREEN								BLUE															
		MSB				LSB				MSB				LSB				MSB				LSB											
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0								
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0			
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1			
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
RED	RED (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	RED (001)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	...	...								...								...															
	RED (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GREEN	GREEN (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	GREEN (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	...	...								...								...															
	GREEN (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	GREEN (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLUE	BLUE (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
	...	...								...								...															
	BLUE (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	
	BLUE (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



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### 3-6. Power Sequence

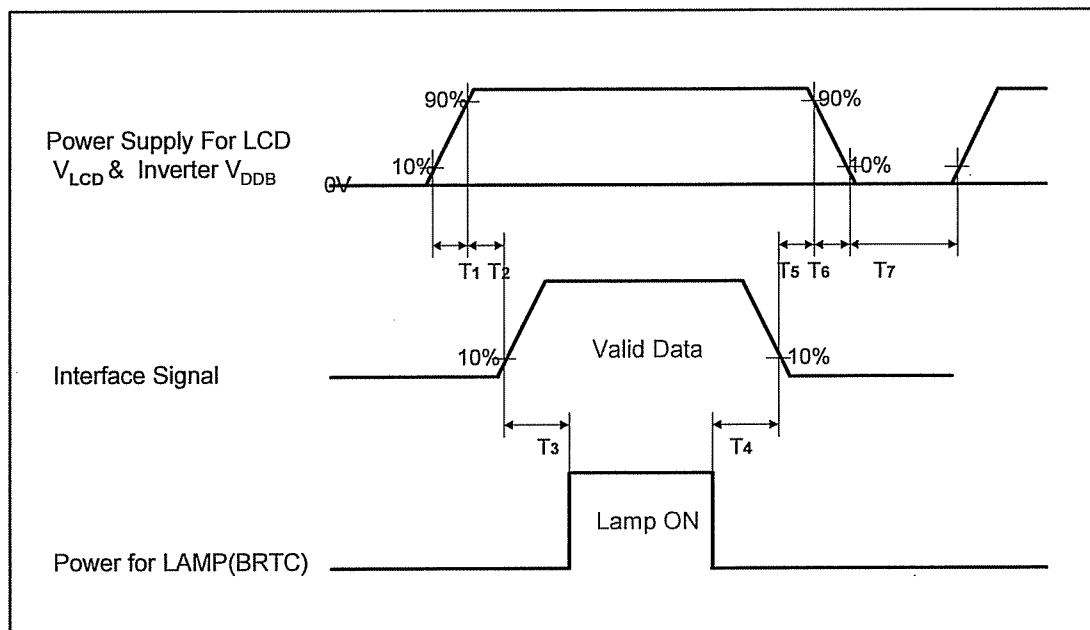


Table 9. POWER SEQUENCE

Parameter	Values			Units
	Min	Typ	Max	
T1	1	-	10	ms
T2	0.5	-	50	ms
T3	200	-	-	ms
T4	200	-	-	ms
T5	0.5	-	50	ms
T6	-	-	10	ms
T7	1	-	-	s

- Notes :
1. Please avoid floating state of interface signal at invalid period.
  2. When the interface signal is invalid, be sure to pull down the power supply for LCD  $V_{DD}$  to 0V.
  3. Lamp power must be turn on after power supply for LCD an interface signal are valid.